

What is claimed

1. An eye viewing device comprising:
a housing having an observer end and a patient end;
an illumination system at least partially disposed in said housing;
an imaging system at least partially disposed in said housing;
an image sensor for generating image signals;
a processor system for processing image information corresponding to image signals generated by said image sensor;
a module holder defined by said housing at said patient end; and
a replaceable module comprising at least said image sensor replaceably received in said holder.
2. The eye viewing device of claim 1, wherein said replaceable module further comprises said processor system.
3. The eye viewing device of claim 1, further comprising an electronic display in communication with said processor system.
4. The eye viewing device of claim 1, wherein said replaceable module further comprises said display.
5. The eye viewing device of claim 1, wherein said display is externally mounted on said module
6. The eye viewing device of claim 1, wherein said display is externally mounted on a face of said module.
7. The eye viewing device of claim 1, wherein said display is externally mounted on said module.
8. The eye viewing device of claim 1, wherein said display is internally mounted in an interior of said module

9. The eye viewing device of claim 1, wherein said display is mounted on a top of said housing.

10. The device of claim 1, wherein said device includes a head worn display apparatus which includes said display.

11. The eye viewing device of claim 1, wherein said device includes a communication link component for facilitating communication of image information externally from said housing.

12. The eye viewing device of claim 2, wherein said replaceable module further comprises said communication link.

13. The eye viewing device of claim 2, wherein said communication link includes a cable.

14. The eye viewing device of claim 2, wherein said communication link comprises a wireless communication link.

15. The eye viewing device of claim 2, wherein said communication link comprises a transportable memory structure.

16. The eye viewing device of claim 2, further comprising an electronic display.

17. The eye viewing device of claim 2, wherein said device further includes an electronic display spaced apart from said housing and said module, and communication with said communication link.

18. The eye viewing device of claim 1, wherein said housing and said module include complementary mating connectors which are adapted to mate when said module is received in said holder.

19. The eye viewing device of claim 3, wherein said processor system is incorporated in said housing and wherein said mating connectors are adapted to provide breakable communication between said image sensor and said processor system.

20. The eye viewing device of claim 3, wherein said processor system is incorporated in said module, and wherein said device further includes a display mounted on said housing, wherein said mating connectors provide breakable communication between said processor system and said display.

21. The device of claim 3, wherein said device includes a battery power supply incorporated in said housing, wherein said mating connectors provide breakable communication between an electronic component of said module and said power supply.

22. The device of claim 3, wherein said module further comprises a communication link component for facilitating communication of image information externally from said housing.

23. An eye viewing device comprising:
a hand-held housing having an observer end and a patient end;
an illumination system at least partially disposed in said housing;
an imaging system at least partially disposed in said housing;
an image sensor for generating image signals; and
a processor system for processing image information corresponding to image signals generated by said image sensor.

24. The eye viewing device of claim 23, further comprising an electronic display in communication with said processor system.

25. The eye viewing device of claim 23, wherein said device includes a communication link component for facilitating communication of image information externally from said hand-held housing.

26. The eye viewing device of claim 23, wherein said hand-held housing further includes a holder defined therein, and wherein said device includes a module replaceably held in said holder, said module including at least said image sensor.

27. The eye viewing device of claim 23, wherein said holder and said module comprises complementary mating connectors which mate when said module is held in said holder.

28. An eye viewing device comprising:
a housing having an observer end and a patient end;
an illumination system at least partially disposed in said housing;
an imaging system at least partially disposed in said housing;
an eyepiece lens for facilitating direct view of an eye structure;
an image sensor for generating image signals;
a processor system for processing image information corresponding to image signals generated by said image sensor; and
a beam splitter intersecting said imaging axis and disposed to define a pair of focal planes, one of said focal planes substantially coinciding with a position of said image sensor, and another of said focal planes defined forward of said eyepiece lens.

29. The eye viewing device of claim 28, wherein said device includes a communication link component for facilitating communication of image information externally from said housing.

30. The eye viewing device of claim 28, wherein said device includes a communication link component for facilitating communication of image information externally from said housing, wherein said housing includes a holder for holding a replaceable module, and wherein said device includes a module replaceably held in said holder, said module including at least said image sensor.

31. The eye viewing device of claim 28, wherein said device includes a communication link component for facilitating communication of image information externally from said housing, wherein said housing includes a holder for holding a

replaceable module, wherein said device includes a module replaceably held in said holder, said module including at least said image sensor, and wherein said module and said holder include complementary mating connectors adapted to mate when said module is held in said holder.

32. The eye viewing device of claim 28, wherein said housing is a hand-held housing.

33. The eye viewing device of claim 28, wherein said device includes a communication link component for facilitating communication of image information externally from said housing, wherein said housing includes a holder for holding a replaceable module, wherein said device includes a module replaceably held in said holder, said module including at least said image sensor, wherein said device further comprises an electronic display.

34. The eye viewing device of claim 28, wherein said device includes a communication link component for facilitating communication of image information externally from said housing, wherein said housing includes a holder for holding a replaceable module, wherein said device includes a module replaceably held in said holder, said module including at least said image sensor, wherein said module and said holder include complementary mating connectors adapted to mate when said module is held in said holder, and wherein said device further includes an electronic display.

35. The eye viewing device of claim 28, wherein said housing is a hand-held housing and wherein said device further includes an electronic display.

36. The eye viewing device of claim 28, wherein said device includes a communication link component for facilitating communication of image information externally from said housing.

37. An eye viewing device comprising:
a housing having an observer end and a patient end;

an illumination system at least partially disposed in said housing;
an imaging system at least partially disposed in said housing;
an eyepiece lens for facilitating direct view of an eye structure;
an image sensor for generating image signals; a processor system for processing image information corresponding to image signals generated by said image sensor; and

a moveable mirror movable between a first position, wherein said mirror defines a focal plane substantially at an active surface of said image sensor, and a second position wherein said mirror is spaced apart from said imaging system so that a focal plane of said imaging system is defined forward of said eyepiece lens.

38. The eye viewing device of claim 37, wherein said device includes a communication link component for facilitating communication of image information externally from said housing.

39. The eye viewing device of claim 37, wherein said device includes a communication link component for facilitating communication of image information externally from said housing, wherein said housing includes a holder for holding a replaceable module, and wherein said device includes a module replaceably held in said holder, said module including at least said image sensor.

40. The eye viewing device of claim 37, wherein said device includes a communication link component for facilitating communication of image information externally from said housing, wherein said housing includes a holder for holding a replaceable module, wherein said device includes a module replaceably held in said holder, said module including at least said image sensor, and wherein said module and said holder include complementary mating connectors adapted to mate when said module is held in said holder.

41. The eye viewing device of claim 37, wherein said housing is a hand-held housing.

42. The eye viewing device of claim 37, wherein said device includes a communication link component for facilitating communication of image information externally from said housing, wherein said housing includes a holder for holding a replaceable module, wherein said device includes a module replaceably held in said holder, said module including at least said image sensor, wherein said device further comprises an electronic display.

43. The eye viewing device of claim 37, wherein said device includes a communication link component for facilitating communication of image information externally from said housing, wherein said housing includes a holder for holding a replaceable module, wherein said device includes a module replaceably held in said holder, said module including at least said image sensor, wherein said module and said holder include complementary mating connectors adapted to mate when said module is held in said holder, wherein said device further includes an electronic display.

44. The eye viewing device of claim 37, wherein said housing is a hand-held housing and wherein said device further includes an electronic display.

45. The eye viewing device of claim 37, wherein said device includes a communication link component for facilitating communication of image information externally from said housing.

46. An eye viewing device system comprising:
a housing having an observer end and a patient end;
an illumination system at least partially disposed in said housing;
an imaging system at least partially disposed in said housing;
a module holder defined by said housing at said patient end; and
at least first and second replaceable modules, each replaceably receivable in said holder, said holder adapted to receive one of said modules at a given time, wherein said first module comprises an eyepiece lens for facilitating direct view of an eye structure and said second module comprises at least an image sensor for generating image signals corresponding to an eye structure.

47. The system of claim 46, wherein said second module further comprises an electronic display.

48. The system of claim 46, wherein said second module further comprises a face mounted display.

49. The system of claim 46, wherein said second module further comprises an externally mounted display.

50. The system of claim 46, wherein said second module further comprises an electronic display mounted in an interior of said module.

51. The system of claim 46, further comprising a communication link component for facilitating communication of image information from said housing.

52. The system of claim 46, wherein said housing is a hand-held housing.

53. The system of claim 46, wherein said holder and said second module comprise complementary mating connectors.

54. A hand held retina viewing device comprising:
a housing;
an image sensor;
an imaging system including an imaging axis;
an illumination system projecting a converging cone of light converging at an apex and diverging thereafter;
wherein said imaging system further includes an aperture stop disposed in said housing substantially conjugate to said apex, and
wherein said retina viewing device is configured to facilitate both visual viewing of said retina and electronic image capturing of an image representing said retina.

55. The device of claim 54, further including a holder receiving a replaceable

module, and wherein said device includes a beam splitter incorporated in said replaceable module.

56. The device of claim 54, wherein said illumination system includes a visible light light source, and wherein light from said visible light light source produces a spot of visible light on said retina during eye entry.

57. The device of claim 54, wherein said illumination system includes a light source disposed off-axis with respect to said imaging axis.

58. The device of claim 54, wherein said illumination system includes a mirror, a light generating light source, and a condenser lens converging light from said light generating light source to a point on said mirror.

59. The device of claim 54, wherein an aperture stop is sized to substantially correspond to a size of a pupil when said device is in an operative position.

60. The device of claim 54, wherein an aperture of said aperture stop is sized substantially according to the formula $d=2m$ millimeters where d is a diameter of the aperture and m is the magnification of a pupil in a plane of said aperture stop when said device is in an operative position.

61. The device of claim 54, wherein said illumination system includes a light source positioned off-axis with respect to said imaging axis, and wherein said off-axis positioned light source is a light generating light source.

62. The device of claim 54, wherein said illumination system includes a light source positioned off-axis with respect to said imaging axis, and wherein said off-axis positioned light source is provided by a light reflective element.

63. The device of claim 54, wherein said imaging system includes an objective lens and said illumination system includes a light source, said objective lens having a curved first surface closest to said light source curved substantially

concentric about a center of an aperture of said aperture stop, whereby internal glare in said device is reduced.

64. The device of claim 54, wherein said illumination system includes a light source positioned outside of a border between received and blocked light defined by said aperture stop, whereby said light source has no obscuring effect on images received by said retina viewing device.

65. The device of claim 54, wherein said illumination system includes a light source positioned outside of a border between received and blocked light defined by said aperture stop and wherein said imaging system includes an objective lens having a curved first surface closest to said light source curved concentric about a center of an aperture of said aperture stop, whereby said light source has no obscuring effect on images received by said retina viewing device, and whereby incident light reflected from said first surface is blocked by said aperture stop.

66. The device of claim 54, wherein a retinal field of view of said imaging system is larger than a retinal area of illumination of said illumination system.

67. The device of claim 54, wherein a retinal field of view of said imaging system is between about 15 to 30 percent larger than a retinal area of illumination of said illumination system.

68. The device of claim 54, wherein said aperture stop is disposed in said device so that said aperture stop is substantially conjugate to said pupil when said illumination system projects substantially a maximum amount of light through said pupil.

69. The device of claim 54, wherein said imaging system includes an objective lens disposed in a path of illumination light rays generated by said illumination system.

70. The device of claim 54, wherein said illumination system includes an

objective lens disposed so that said imaging axis intersects said lens.

71. A hand held retina viewing device comprising:

a housing;

an image sensor;

an imaging system including an imaging axis and an aperture stop;

an illumination system including a light source;

wherein said imaging system further includes an objective lens having a surface closest to said light source curved substantially concentric about a center of an aperture of said aperture stop, whereby internal glare in said device is reduced, and
wherein said retina viewing device is configured to facilitate both visual viewing of said retina and electronic image capturing of an image representing said retina.

72. The device of claim 71, further including a holder receiving a replaceable module, and wherein said device includes a beam splitter incorporated in said replaceable module.

73. The device of claim 71, wherein said illumination system includes a visible light light source, and wherein light from said visible light light source produces a spot of visible light on said retina during eye entry.

74. The device of claim 71, wherein said light source is disposed off-axis with respect to said imaging axis.

75. The device of claim 71, wherein said illumination system includes a mirror, a light generating light source, and a condenser lens converging light from said light generating light source to a point on said mirror.

76. The device of claim 71, wherein an aperture stop is sized to substantially correspond to a size of a pupil when said device is in an operative position.

77. The device of claim 71, wherein an aperture of said aperture stop is sized

substantially according to the formula $d=2m$ millimeters where d is a diameter of the aperture and m is the magnification of a pupil in a plane of said aperture stop when said device is in an operative position.

78. The device of claim 71, wherein said illumination system includes a light source positioned off-axis with respect to said imaging axis, and wherein said off-axis positioned light source is a light generating light source.

79. The device of claim 71, wherein said illumination system includes a light source positioned off-axis with respect to said imaging axis and wherein said off-axis positioned light source is provided by a light reflective element.

80. The device of claim 71, wherein said illumination system includes a light source positioned outside of a border between received and blocked light defined by said aperture stop, whereby said light source has no obscuring effect on images received by said retina viewing device.

81. The device of claim 71, wherein said illumination system includes a light source positioned outside of a border between received and blocked light defined by said aperture stop and wherein said imaging system includes an objective lens having a curved first surface closest to said light source curved concentric about a center of an aperture of said aperture stop, whereby said light source has no obscuring effect on images received by said viewing device, and whereby incident light reflected from said first surface is blocked by said aperture stop.

82. The device of claim 71, wherein said imaging system includes a beam splitter splitting imaging light rays between a first path directed toward a visual viewing eye piece and a second path directed toward an electronic image sensor.

83. The device of claim 71, wherein a retinal field of view of said imaging system is larger than a retinal area of illumination of said illumination system.

84. The device of claim 71, wherein a retinal field of view of said imaging

system is between about 15 to 30 percent larger than a retinal area of illumination of said illumination system.

85. The device of claim 71, wherein said aperture stop is disposed in said device so that said aperture stop is substantially conjugate to said pupil when said illumination system projects substantially a maximum amount of light through said pupil.

86. The device of claim 71, wherein said imaging system includes an objective lens disposed in a path of illumination light rays generated by said illumination system.

87. The device of claim 71, wherein said illumination system includes an lens disposed so that said imaging axis intersects said lens.

88. A retina viewing device comprising:

a housing;

an imaging system including an objective lens and an imaging lens disposed in said housing through which retinal image forming light rays pass, wherein said imaging system is configured to facilitate visual viewing of said retina and electronic image capture of an image of said retina;

an illumination system configured to project illumination light rays, said illumination system including a light source and said objective lens, wherein at least some of said illumination light rays pass through said objective lens, wherein said light source and said objective lens are disposed in said housing at fixed positions relative to one another, and

wherein said device is configured to be hand held.

89. The retina viewing device of claim 88, wherein said imaging system includes an image sensor and a beam splitter splitting received retinal image forming light rays between a first path in a direction toward a viewer's eye and a second path in a direction toward said image sensor.

90. The retina viewing device of claim 88, wherein said imaging system include an image sensor and a moving mirror moveable between a first position at which retinal image forming light rays are directed toward said image sensor, and a second position at which retinal image forming light rays travel toward a viewer's eye.

91. The retina viewing device of claim 88, wherein said imaging system includes an image sensor and a moving mirror moveable between a first position at which a retinal image focal plane is defined at an active surface of said image sensor and a second position permitting visual viewing of said retina.

92. The device of claim 88, wherein said illumination system includes a visible light light source, and wherein light from said visible light light source produces a spot of visible light on said retina during eye entry.

93. The device of claim 88, wherein said illumination system includes a light source disposed off-axis with respect to said imaging axis.

94. The device of claim 88, wherein said illumination system includes a mirror, a light generating light source, and a condenser lens converging light from said light generating light source to a point on said mirror.